

latitude. This region in the Southern Hemisphere corresponds to a portion of the Northern Hemisphere, extending north and south, between Turks Island, the Bahamas, and Nain, Labrador, and, east and west, between the meridians of Washington, D. C., and Cape Farewell, Greenland. When this large region in the Southern Hemisphere shall have had its storms and "pamperos," its isobars and isotherms thoroughly studied, we shall feel that a great advance has been made in the meteorology of the globe.

We are not informed whether the daily weather map of the Province of Buenos Ayres, published for ten years past by the Observatory at La Plata, will be discontinued, but evidently the much more comprehensive work of the general Department of Agriculture must supersede that.

The elaborate presentation of Argentine climatology compiled by Dr. Davis for the official volume of statistics of that republic is about to appear, in Spanish and English text, as a special treatise by him on the climate of that region. The climatology of Dr. Davis and his new daily weather map show that the meteorology of the South Temperate Zone of America is in excellent hands.—C. A.

#### DANCING DERVISHES OR DUST WHIRLS.

A correspondent from Statesville, N. C., under date of June 6, 1902, sends the following interesting description of a phenomenon observed by him:

I have seen many whirlwinds but never before one like that observed yesterday about 3:30 p. m., some 4 miles south of Statesville. It consisted of four separate whirlwinds which followed each other to the left around the center of a circle 10 or 15 feet in diameter, like horses going around a horse power thrashing machine. The whole circle also seemed to be moving to the left and around the center of an enlarging coil. The motion was made apparent by dust taken up from the soil, and it could not well be seen above 10 or 15 feet from the ground. Sometimes, one or more of the small whirls would rise so as not to be visible, but presently it would touch the soil again in its regular place in the procession. This beautiful and curious motion continued for five minutes or more over a spot only about 100 feet in diameter. It then advanced northward the four whirls enlarging their circle to about 75 yards and then vanishing.

Dust whirls like that described above are not uncommon in hot, dry regions like the interior of Africa or India. One was observed in Kansas in 1897 (see MONTHLY WEATHER REVIEW, Vol. XXVII, p. 111), but they are not often seen in this country. The following description from Whirls and Dust-Storms of India, by P. F. H. Baddeley, London, 1860, may be of interest:

Another curious phenomenon is often observed in a slowly-moving whirlwind; instead of appearing as a simple column, the dust whirl in contact with the ground, and for a few feet upward, is found to be composed of several distinct vortices, or spiral bodies, each one rotating on its axis as it revolves round and round the whirling circle. Each separate vortex having attached to it in its horizontal section, the same kind of fan-shaped train of dust, as was before remarked with regard to the smaller whirlwind columns.

This remarkable sight gives the idea of a fairy dance round a ring; and the motions are from all accounts, exactly imitated by the dancing Dervishes of Turkey; one of their holy exercises being to whirl round and round like a top; singly, or in company with several others, performing at the same time a gyration round in a circle, as if their dance originated in the very phenomenon now described. We may sometimes watch this motion for a length of time, without changing our position more than a few yards.

Buchan in his Handbook of Meteorology, London, 1868, page 306, gives the following explanation of these dust whirls:

Whirlwinds are often originated in the Tropics during the hot season; especially in flat, sandy deserts, which becoming unequally heated by the sun, give rise to numerous ascending currents of air. In their contact with each other, these ascending currents give rise to eddies, thus producing whirlwinds which carry up with them clouds of dust. Of this description are the *dust-whirlwinds* of India, which have been described and profusely illustrated by P. F. H. Baddeley.—H. H. K.

#### THE VARIATIONS OF THE TEMPERATURE OF THE FREE AIR AT GREAT ALTITUDES.

In the MONTHLY WEATHER REVIEW for September, 1899, Vol. XXVII, p. 411, we published a translation of a memoir by

Monsieur L. Teisserenc de Bort communicating the results of over 100 balloon ascensions, made at his observatory at Trappes, near Paris, for the purpose of investigating the temperature of the upper air. Up to that time meteorologists had generally assumed that as we ascend in the atmosphere not only do the regular diurnal and annual ranges of temperature, but also the nonperiodic or irregular variations, steadily diminish, so that we soon attain a region of uniform temperature. As a first result of the work of Teisserenc de Bort it seemed likely that the nonperiodic variations diminished very little with altitude so that we never attain a region in which the air temperature remains constant throughout the year. But a more careful examination of these data by Assmann and Berson, and especially their analysis of the temperatures observed in the balloon ascensions made from Berlin, made it evident that a region of uniform temperature, after all, may exist, but much higher up than was formerly supposed. A further contribution to this subject has lately been published by Teisserenc de Bort in the Comptes Rendus of the Paris Academy of Sciences for April 28, 1902, Vol. CXXXIV, pp. 987-989, showing the variations of temperature actually observed in the zone between 8 and 13 kilometers high; this we present to our readers in the following translation.—C. A.

I have the honor to communicate to the Academy the results of the discussion of observations made during 236 ascents of sounding balloons sent up from my observatory for dynamic meteorology, and which rose above 11 kilometers; 74 of them attained a height of 14 kilometers. These observations extend over several years and are distributed throughout the various seasons. They permit us for the first time to study the temperature of the atmosphere in the zone above a height of 10 kilometers, bringing to light new and unexpected facts, of which the following are the more striking:

1. In general the diminution of temperature with altitude increases as we leave the lower layers and attains in the upper regions hitherto explored a value quite near to that which corresponds to the adiabatic rate in dry air, but this decrease, instead of going on proportionally as we ascend as was formerly assumed, passes through a maximum, then diminishes rapidly until it becomes nearly zero at an altitude which in our region is on an average about 11 kilometers.

2. Starting with an altitude that varies between 8 and 12 kilometers, according to the atmospheric condition, there begins a zone characterized by a very small rate of diminution of temperature, or even by a slight increase, with alternations of cooling and warming. We are not able to state precisely the thickness of this zone, but, according to the observations already made, it would seem to amount to at least several kilometers.

This is a fact of which we were ignorant up to the present time, and it deserves to be taken into very serious consideration in the study of the general circulation. I ought to add that these results are not in agreement with many previous conclusions that had been based upon very insufficient evidence.

By considering the daily atmospheric conditions, we shall at once perceive that the point of inflection of the curve of temperatures varies within rather wide limits, between the altitudes 8 and 13 kilometers. This fact has attracted my attention ever since the ascents of our sounding balloons at night-time furnished sufficiently accurate data.<sup>1</sup> We quickly recognized that the ascensions in which the temperature ceases to decrease at an altitude of 8 or 9 kilometers are made during weather that is under the influence of barometric depressions, and that, on the contrary, the ascensions during high pressure are characterized by an elevation of the zone where the temperature tends to become uniform.

I have given to the Physical Society of Paris, in my communication of June 16, 1899, a very fine example of this phenomenon, by comparing the curves of the 14th and of the 23d of March, 1899; nevertheless as this result was absolutely new and contrary to theoretical predictions, I desired to multiply the experiments and overcome as far as possible the many causes of error before presenting the results to the Academy.

I had first to endeavor to secure ascensions, under difficult circumstances, that should attain altitudes sufficient to assure that the phenomenon to be studied should not be confined to the extreme or highest portion of the ascent of the balloon. As we approach the equilibrium stage (where the balloon floats along horizontally), the ventilation due to the ascending movement falls and we must fear the influence on the thermometer of the radiation from the sun and from the balloon, as also the influence of the mass or sluggishness of the self-register itself. After

<sup>1</sup> I have already explained to the Academy, in my note of 1898, the precautions taken in order to prevent the balloon from passing too rapidly in a vertical direction through the layers of air and to thus overcome the sluggishness of the thermometers.

persevering efforts we succeeded in sending up, even in bad weather, paper balloons carrying self-registers to altitudes of 13 and 14 kilometers. Notable improvements in the instruments have enabled us to isolate the sensitive portion of the thermometer from the mass of the self-register, whose calorific sluggishness is quite large.

The records of much higher precision obtained under these conditions have fully confirmed that which we had at first noticed, and we have been able to separately consider the curves of the self-registers for different conditions, or types, of weather.

The following table is a résumé of this classification as arranged in two groups both of which indicate the same result.

*Résumé of temperature measurements by means of sounding balloons.*

	Years.	Location of center of high pressures.					Location of station relative to low pressures.			
		East of Europe.	Over France and Gulf of Gascony.	Over France.	West of Europe.	South and south-west of the low.†	In front.	At the side.	In path.	In central part.
Altitude of isothermal zone.*	1899-0	<i>Kilo.</i> 11.3	<i>Kilo.</i> 12.1	<i>Kilo.</i> 11.7	<i>Kilo.</i> 11.2	<i>Kilo.</i> 12.2	<i>Kilo.</i> 11.4	<i>Kilo.</i> 11.3	<i>Kilo.</i> 9.9	<i>Kilo.</i> 10.4
	1901-2	11.3	12.8	11.4	11.1	12.5	11.5	11.3	11.9	9.7
Altitude of zone of less than 0.4° temperature decrease per 100 meters.	1899-0	10.0	10.7	10.8	10.1	11.0	10.5	10.5	9.1	9.6
	1901-2	10.0	11.5	10.8	10.7	10.5	10.4	10.5	9.6	8.6
Altitude of zone of maximum rate of temperature decrease.	1899-0	8.0	8.7	8.8	7.7	9.2	8.2	8.3	7.4	8.1
	1901-2	8.0	8.8	8.4	8.5	8.6	8.1	8.3	8.1	7.1
Mean value of maximum rate of decrease.	1899-0	0.93	0.95	0.92	0.87	0.89	0.89	.....	0.93	0.92
	1901-2	0.93	0.88	0.91	0.90	0.95	0.88	0.90	0.89	0.92

\*That is, no vertical gradients.—Ed.

†So in original, but may be a misprint for "the station."—Ed.

As is shown by this table, the altitude of the isothermal zone is in the neighborhood of 12.5 kilometers in the central portions of the areas of high pressure and north of these, but descends to 10 kilometers in the centers of areas of low pressure. Hereafter we shall see the correlation of this altitude above sea level with the temperature of the air under these opposing atmospheric conditions.

#### HALOS, PARHELIC CIRCLES AND CONTACT CIRCLES.

Mr. J. A. Warren, Voluntary Observer, Santee, Nebr., sends us the following:

To-day (June 23) at 1:15 p. m., my attention was called to a peculiar halo which my informant called a rainbow, but it was no rainbow. It was a broad band of rainbow colors below the sun, and perhaps a little nearer to the horizon than to the sun. It appeared perfectly horizontal with no curvature toward or from the sun, and extended about one-ninth of the distance around the sky. It was very wide, perhaps 7°, and the colors all very distinct, the red being toward the sun. The halo continued about thirty minutes after I first saw it. The sky was overcast with a thin layer of stratus clouds and one of cirrus also. Soon after the disappearance of this halo the 22° halo appeared. Can you tell what this was? I should think it the 45° ring, except that it did not curve toward the sun and was so very wide.

A great variety of circles have been observed about the sun; they may be divided into the three following classes:

1. Halos, having the sun at the center;
2. Parhelic circles, passing through the sun;
3. Contact circles, tangent to the halos.

At least three varieties of halos have been observed: *a*, the most common of all having a radius of 22°; *b*, a halo of 46° radius; *c*, the great circle of Hevelius, having a radius of 90°. The first two of these are red on the inner side, or the side nearest the sun, and blue on the outer side, while the third is nearly white.

Four parhelic circles have been described; one parallel to the horizon, one perpendicular to it, and two very faint ones about 30° on either side of the latter. These four circles are white.

A great number of contact circles have been observed tangent to the halos, most commonly occurring at the highest and low-

est points of the 22° and 46° circles. The one tangent at the highest point of the 46° circle, and both those tangent to the 22° circle, have been described as horizontal, or circumzenithal, circles, but I have been unable to find a description of a horizontal circle tangent to the lowest point of the 46° circle previous to that here given by Mr. Warren. It frequently happens, as was the case at Santee, that the tangent circle alone is observed, the halo itself being invisible.

At the numerous intersections of these various circles, parhelia, or mock suns, or sundogs, are formed, often of great brilliancy.

A more complete description of these phenomena may be found on pages 216 to 225 of Loomis's *Treatise on Meteorology*; pages 422-440 of Kämtz's *Meteorology*, translated by C. V. Walker, London, 1845; and on pages 295 and 305 of the *MONTHLY WEATHER REVIEW* for July, 1897, Vol. XXV.

In fig. 1 is reproduced a sketch of a brilliant solar halo observed at Fort Egbert, Alaska, transmitted by Mr. C. C. George-son, special agent in charge of the Experiment Station of the United States Department of Agriculture, at Sitka, Alaska.

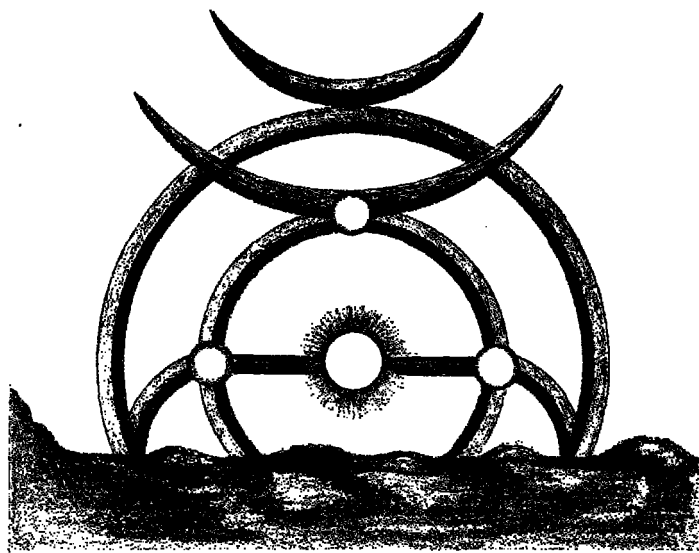


FIG. 1.—A brilliant solar halo.

No description accompanied the sketch, but apparently there were observed the halos of 22° and 46° radius, contact circles at the highest point of each of these, a horizontal parhelic circle, three parhelia on the 22° circle, with prolongations from those at the intersection of the 22° circle with the parhelic circle. In the original sketch the horizontal circle is made to appear red on the lower and blue on the upper side, but this could hardly be the case, since this circle is supposed to be caused by the reflection of light from the vertical faces of snow crystals, while the halos and the contact circles are produced by the refraction of light that passes through the snow crystals.

These phenomena are seen at their best in high latitudes when the sun is near the horizon, as was the case at Fort Egbert on March 21, 1902.—H. H. K.

#### ERRATA.

MONTHLY WEATHER REVIEW, August, 1901, page 365, column 1, equation (a), for "W" read "log W."

MONTHLY WEATHER REVIEW, May, 1902, page 250, column 1, line 5 from the bottom, for "produces" read "maintains"; page 255, Table 19, column 8, line 7, for "8125" read "3125"; page 257, column 2, line 8 from bottom, for "expected" read "anticipated"; page 258, column 1, line 12, for "the tornado tube" read "the half of a tornado tube".